Overview

The Lithium radio product line provides a CubeSat compatible communication system for extreme environment applications. Lithium radios feature on-the-fly selectable frequency selection and output power. They are compatible with standard amateur radio ground stations capable of communication at 9600 bps, or higher bit rates using GMSK modulation.

The Lithium series radios (Li-1,Li-2) are half-duplex radios with adjustable communications parameters. Custom frequencies and deviations are available per customer requirements.

The Lithium series radios are available as an SMT module that can be placed on a half size PC104 board or can be integrated into larger more complex systems without incurring RF complexity in host products.

A digital command and data interface is provided to the radios. Through this interface the radio is configured, data is received, and data is sent for transmission. The interface protocol is serial UART and configurable up to 115.2 kbps. A packet protocol with checksums is implemented between the host and radio for robust access.

The radios communicate using a subset of the AX.25 packet protocol (custom protocols can be ordered). The AX.25 packet source and destination call signs are configurable.

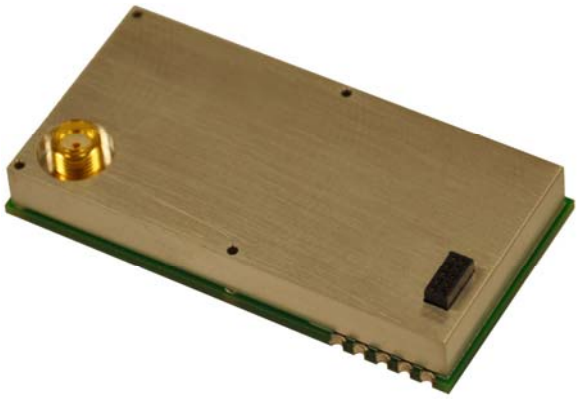

Figure 1--Picture of the Li-2 Radio.

Applications:

- **CubeSat Kit systems**
- **High altitude balloon missions**
- **Rovers or other remotely operated vehicles**
- **Remote embedded systems**

Features:

- **FSK/GMSK transceiver**
- **Frequencies:**
  - **130 – 450MHz**
- **Input voltages:**
  - **Radio power supply (6-12V)**
- **Output transmit power: 250 mW – 7 W**
- **Power usage:**
  - **Receive < 200 mW**
  - **Transmit: < 28 W [1]**
- **Data rate: 9.6 kbps [2]**
- **Protocol support: AX.25, raw**
- **Serial interface: 3.3V UART**
- **Form factor:**
  - **SMT module (32 mm x 62 mm)**
- **Operating Temperature: -20 to +60 °C**
- **AES 128 or 256 Encryption [3]**

Options:

- **Connector options RA SMA, MCX**
- **BPSK**

For more information, contact:
info@astrodev.com

Li-2 emits RF radiation that may interfere with the use of other devices. Users must maintain proper licenses during operation.

Li-2 is static sensitive, take the necessary precautions

Li-2 requires proper termination of transmitter in 50 Ohm load during operation.

[1] Transmission power is configurable by the user. Maximum is noted.
[2] Higher data rates require special licensing, 19.2kbps, 38.4kpbs, 76.8kbps, etc
[3] Encryption not AX.25 compliant.

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ABSOLUTE MAXIMUM RATINGS

Interface Parameter	Symbol	Min.	Nom.	Max.	Units
Operating temperature	T_{OP}	-30.0 to +70.0			˚C
DC Radio Voltage	V_{amp}	6.0		12.0	V
DC Radio Current	I_{amp}	0.02		2.0	A

Input and Output Pins	Symbol	Min.	Nom.	Max.	Units
Input Voltage Logic High	V_{high}	2.6	3.3	3.6	V
Input Voltage Logic Low	V_{low}	0.0		0.66	V
Current Source High	I_{high}		10		mA
Current Sink Low	I_{low}		10		mA

RF Interface	Symbol	Min.	Nom.	Max.	Units
RF Output		-70		38	dBm

PHYSICAL CHARACTERISTICS

Physical Parameter	Symbol	Min.	Typ.	Max.	Units
Mass*	M	30		52	g
Height*	H	0.0		10	mm
Width*	W		32	33	mm
Length*	L		64	65	mm

* RF Connector Option Dependent Please refer to IGS file information at www.astrodev.com for physical characteristics.

INTERFACE PIN DESCRIPTION

Interface Pin Name	Pin #	Notes
TX_UART	1	UART TX, Information Out
RX_UART	2	UART RX, Information In
RESET	3	Reset radio, logic low
GND	4	Radio supply ground
3.3V_RADIO	5	3.3V Radio Internal Supply – Output From Radio
V_AMP	6	Amplifier Voltage
V_AMP	7	Amplifier Voltage
RF_GND	8	Amplifier Ground
RF_GND	9	Amplifier Ground
GPIO_BSL	10	Radio GPIO Pin For Bootloader
GPIO_BSL	11	Radio GPIO Pin For Bootloader
External_Event	12	External event pin, configurable output
Config_Pin_2	13	External configuration pin, logic input
Config_Pin_1	14	External configuration pin, logic input
Thermal_PAD	15	Bottom pad for thermal dissipation, connect to RF_GND

LITHIUM MODULE SCHEMATIC DESCRIPTION

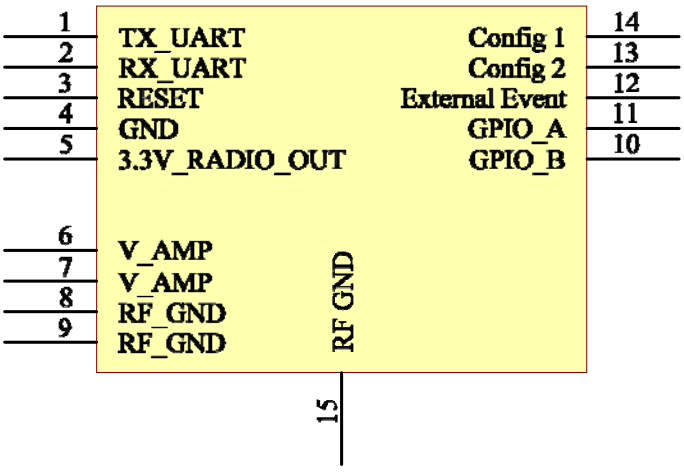

Figure 2 Lithium PCB Mount Module Schematic Diagram

PROGRAMMING PORT PIN DESCRIPTION

Program Pin Name	Pin #	Notes
DATA CLOCK	1	Reserved
RESET	2	JTAG Processor Reset
DATA	3	Reserved
TCK	4	JTAG Clock
3.3VD	5	JTAG 3.3V Power
TDI	6	JTAG Data In
TMS	7	JTAG Test Mode Select
TDO	8	JTAG Data Out
GND	9	Ground
N/C	10	No Connection

LITHIUM MODULE PROGRAMMING PORT SCHEMATIC DESCRIPTION

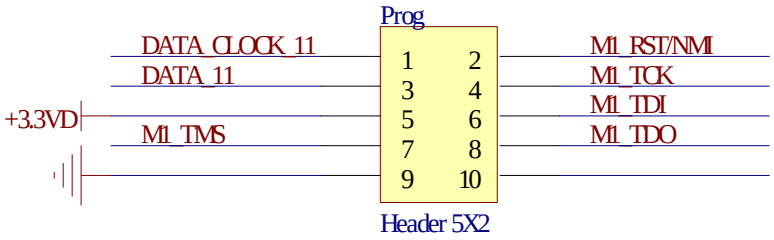

Figure 3 Programming Port Schematic Diagram

The programming adapter provided with the radio converts the 1.27mm connector to a standard 0.1” JTAG header. The JTAG adapter plugs inline with the radio with the majority of the adapter pointed away from the Li-2 radio. In the following figure demonstrates the proper mating of the JTAG adapter.

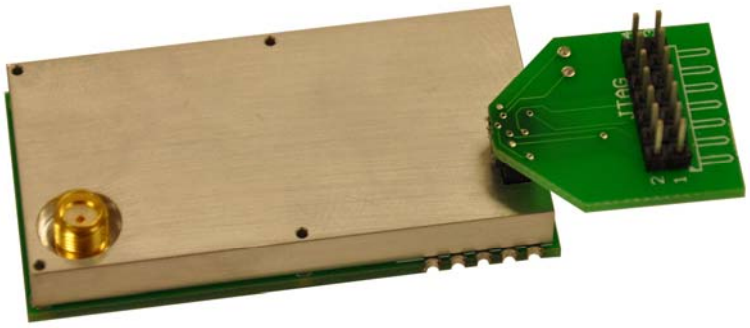

Figure 4 JTAG Adapter Plug Demonstrations

COMMUNICATING WITH THE LITHIUM RADIO

Refer to AstroDev radio interface application note for detailed instructions.

RADIO CONFIGURATION PROGRAM

Refer to radio configuration program application note for detailed instructions.

DIMENSIONS AND FORM FACTOR

For detailed dimension information please refer to IGS model on www.astrodev.com

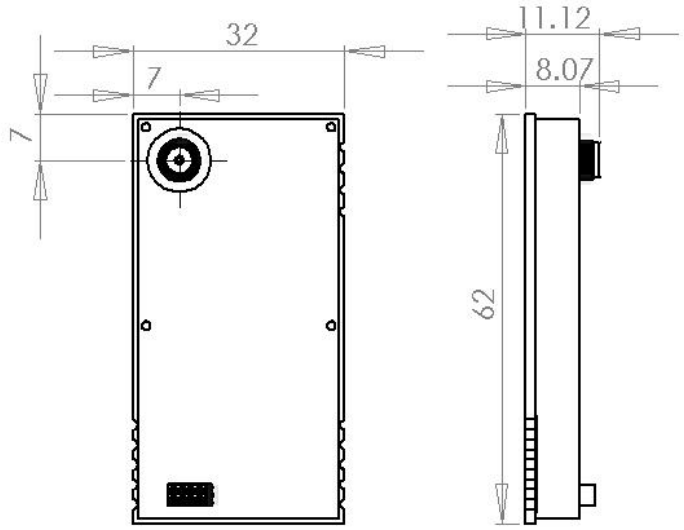

Figure 5 – Straight SMA Li-2 Radio (All dimensions in mm)

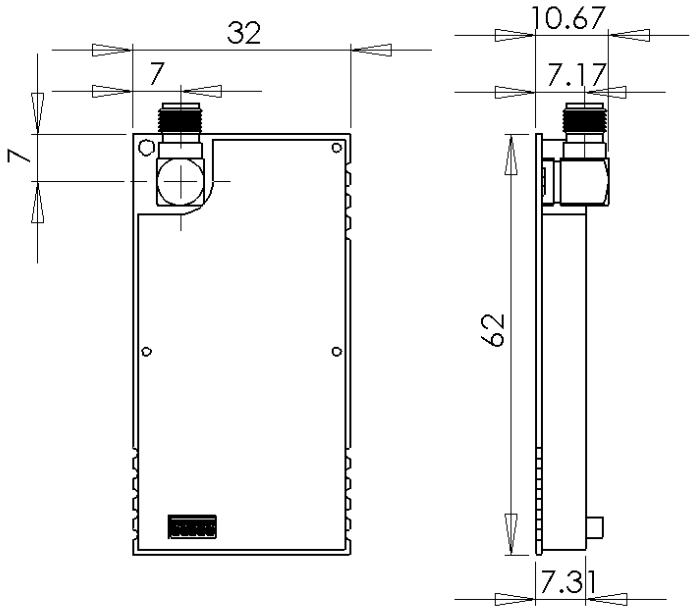

Figure 6 – Right Angle SMA Li-2 Radio (All dimensions in mm)

RECOMMENDED FOOTPRINT

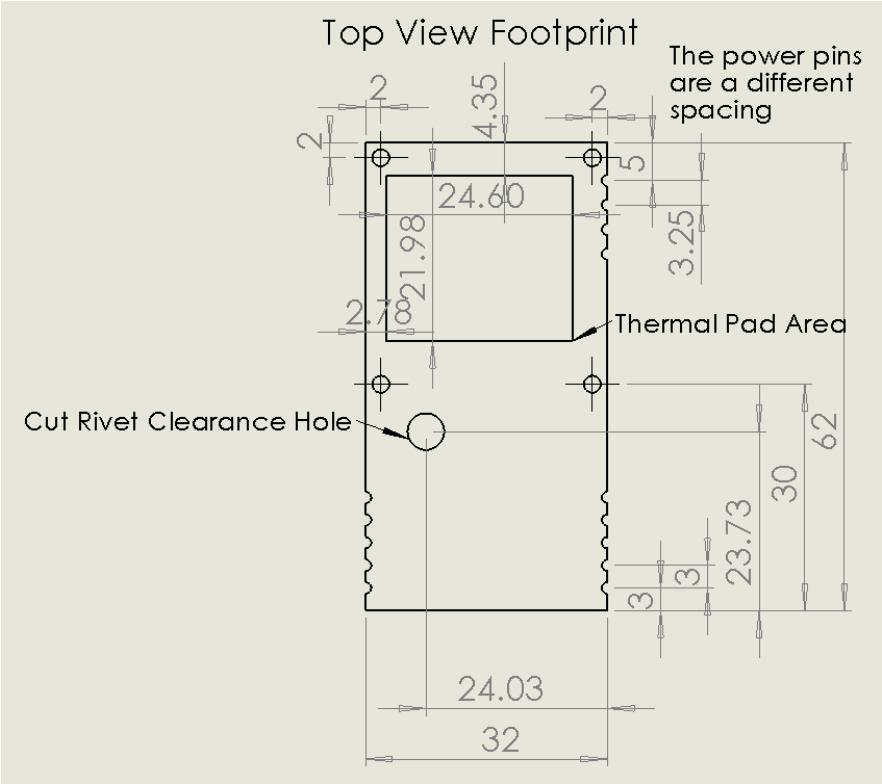

Figure 7 Recommended PCB Footprint (All dimensions in mm)

Please refer to www.astrodev.com for footprints in PCB layout programs.

Mounting of the Li-2 module using hand soldering is recommended. An iron temperature of 350°C should be used with IPC recommendations / reference documents IPC7711. Place the module precisely on the pads. Start with a cross-diagonal fixture soldering (e.g. pins 14 and 9), and then continue from left to right. Thermal compound should be applied to the thermal conduction area under the module. The thermal conduction area should include through hole vias that connect to a ground plane to promote thermal dissipation. Proper analysis is required to ensure that the module is able to properly dissipate heat within its application environment.

Reflow or wave soldering of the Li-2 module is not recommended. Thermal dissipation through the module heatsink occurs in high temperature environments resulting in inconsistent soldering joints.

Conformal coating or casting of the module is permitable as long as thermal analysis is performed to realize the new thermal environment. The module should be operated at as low temperature as possible toward a nominal 20 °C to increase overall efficiency and precise operation.

PROTECTING AGAINST ELECTROSTATIC DISCHARGE

CAUTION: Disconnect the Li-2 radio from power source before removing from operating environment.

Electrostatic discharge (ESD) events can harm electronic components inside the Li-2. Under certain conditions, ESD may build up on your body or an object, such as an antenna, and then discharge into another object, such as the Li-2. To prevent ESD damage, you should discharge static electricity from your body before you interact with any electronic components.

You can protect against ESD and discharge static electricity from your body by touching a metal grounded object (such as an unpainted metal surface such as your antistatic surface) before you interact with anything

electronic devices. When connecting an antenna or power plug to the Li-2, you should always ground both yourself and the CubeSat structure before connecting it.

You can also take the following steps to prevent damage from electrostatic discharge:

• When unpacking the Li-2 from its shipping carton, do not remove the radio from the antistatic packing material until you are ready to install the component. Just before unwrapping the antistatic package, be sure to discharge static electricity from your body by wearing an antistatic wrist strap.

• When transporting the Li-2, first place it in an antistatic container or packaging.

• Handle the Li-2 in a static-safe area. If possible, use antistatic floor pads and work bench pads.

TRADEMARKS
In progress.

DISCLAIMER
All information in this document is subject to change at anytime. Look for continued updates at: http://www.astrodev.com/

Lithium radios are sold as test devices and require users to gain experimental license from the FCC for use in terrestrial and CubeSat satellite missions.

NOTES